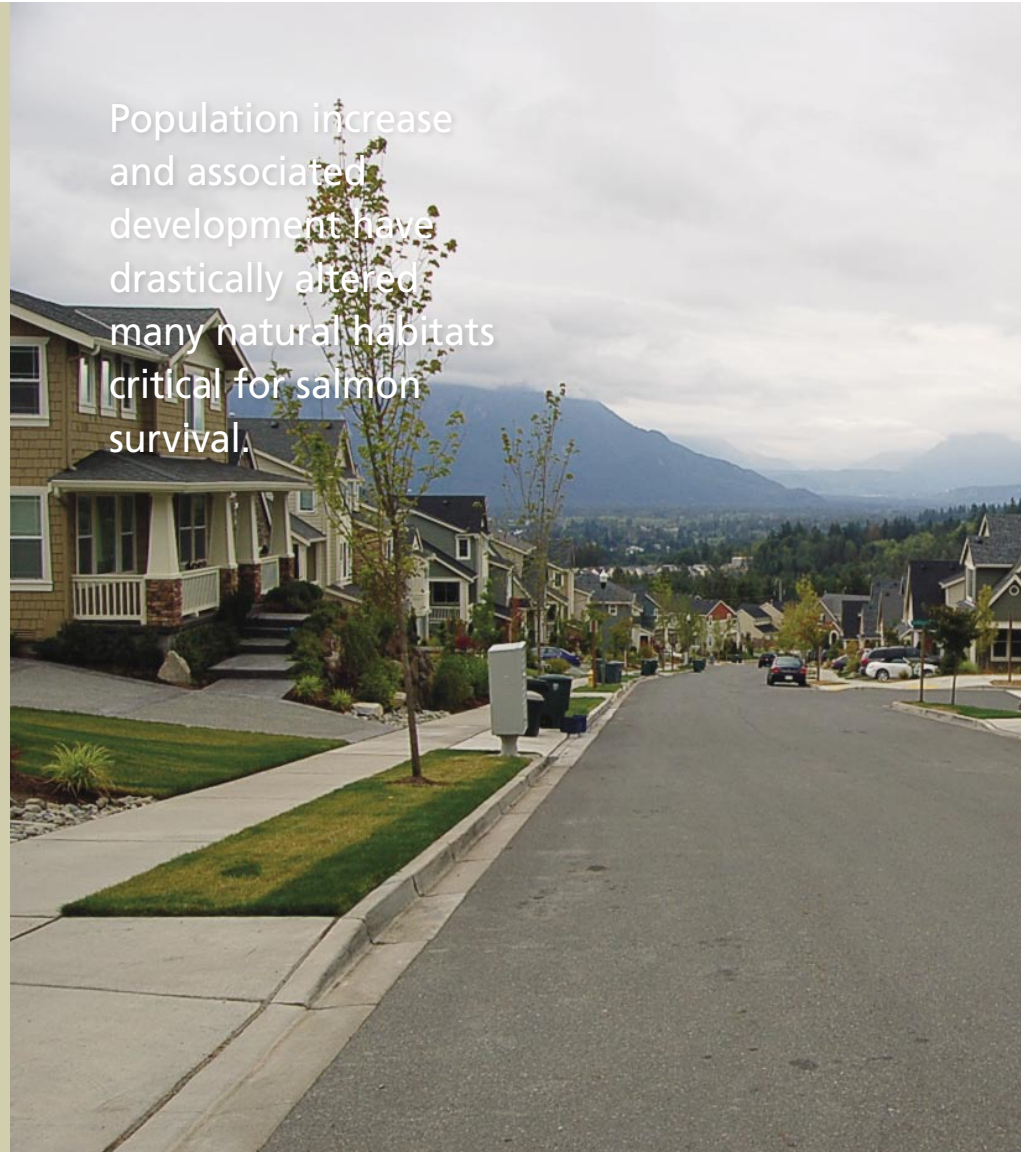


Threats to Salmon Recovery

To achieve our goals of restoring salmon to healthy and harvestable levels, diverse and abundant salmon populations are necessary across the state. Our recovery plans give us guidance on what types of things need to be done and where, but we must also recognize the forces which contributed to salmon decline are continuing to exert pressures. These stresses are commonly called “threats” and will make salmon recovery more difficult if we don’t understand them and account for their potential.²⁹ They range from global issues such as climate change and habitat conversion, to more local problems as managing population growth without impacting economic growth. We have selected a few threats that could have particular significance in our efforts to recover salmon in Washington.

Population increase and associated development have drastically altered many natural habitats critical for salmon survival.

CHRIS DRIVDAHL



The Impact of a Growing Population

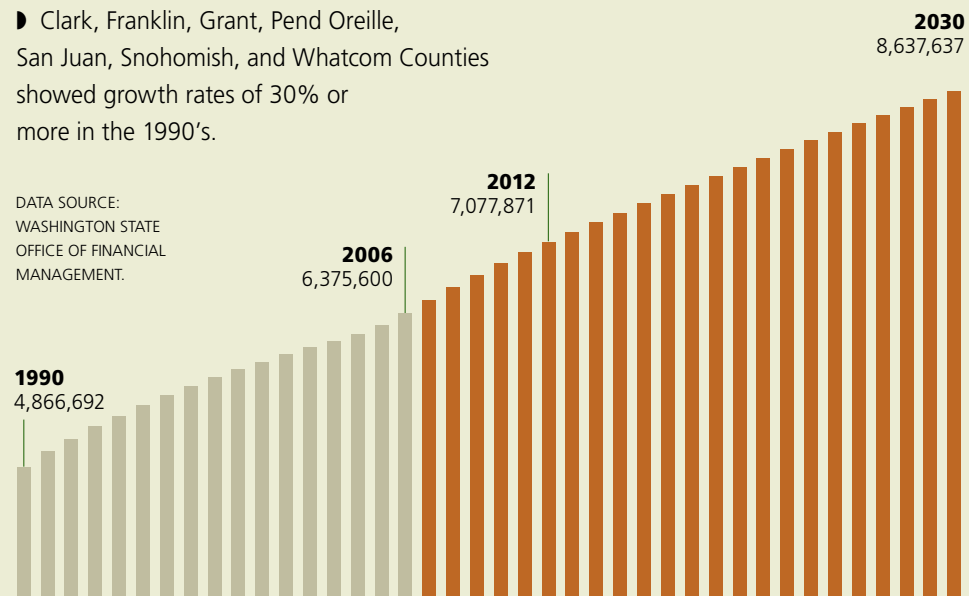


Population increase and associated development have drastically altered many natural habitats critical for salmon survival. The State Office of Financial Management's Forecasting Division estimates show:

- ▶ The state's population has grown by 20% every 10 years since the 1960's.
- ▶ The state reached 5.9 million in 2000 and will approach 7.6 million by 2020.
- ▶ During the 1990's, 4 westside counties each gained over 100,000 people and no county declined in population.
- ▶ Clark, Franklin, Grant, Pend Oreille, San Juan, Snohomish, and Whatcom Counties showed growth rates of 30% or more in the 1990's.

DATA SOURCE:
WASHINGTON STATE
OFFICE OF FINANCIAL
MANAGEMENT.

POPULATION FORECAST



Energy Use

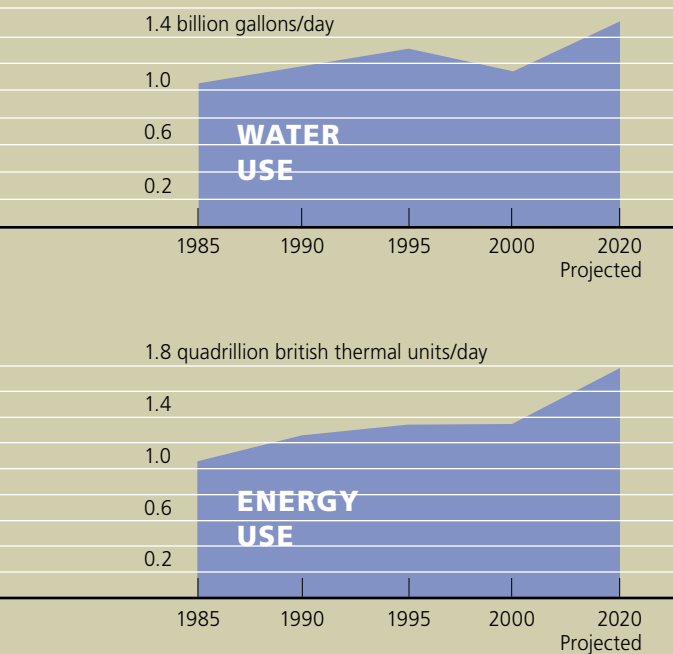
Energy use has a profound impact on our environment. Although we have lessened our impact on natural resources in many ways, population growth and concomitant energy uses will affect the long-term sustainability of our land and water habitats. Consider these figures:

- ▶ End use energy consumption in Washington was 54% higher in 2001 than in 1970.
- ▶ Energy use in the transportation sector has more than doubled since 1970.
- ▶ Growth in household electricity consumption has slowed in the last 20 years, while growth in use of natural gas has accelerated.
- ▶ Energy consumption per capita has been relatively constant for the last 20 years with growth in energy use matching growth in population.
- ▶ If we maintain energy consumption at 2001 per capita rates, by 2020 we will increase the total use 29%; to keep usage effects consistent with 2001 levels, we will need to reduce our present rate of per capita consumption by 23%.



Energy consumption per capita has been relatively constant for the last 20 years with growth in energy use matching growth in population.

Water Use



DATA SOURCE: US GEOLOGICAL SURVEY, WSU EXTENSION ENERGY PROGRAM, AND WASHINGTON COMMUNITY, TRADE, AND ECONOMIC DEVELOPMENT.

As our population grows, the consumption of natural resources usually rises as well. For example,

- ▶ In 1985, total public supply and domestic water use was 1052.96 million gallons per day (MGD).
- ▶ In 2000, that number had risen to 1140.88 MGD, an increase of 8% at a time when the population increased by 33%.
- ▶ This means that per capita use declined by 19% over this 15 year period.
- ▶ If we want to keep the effects of water use in 2020 consistent with today's environment, our per capita use number will need to decline another 25%.
- ▶ Maintaining our current per capita use of water—193.5 GPD—in 2020 will result in an increase in total use of water of 31% more than today.



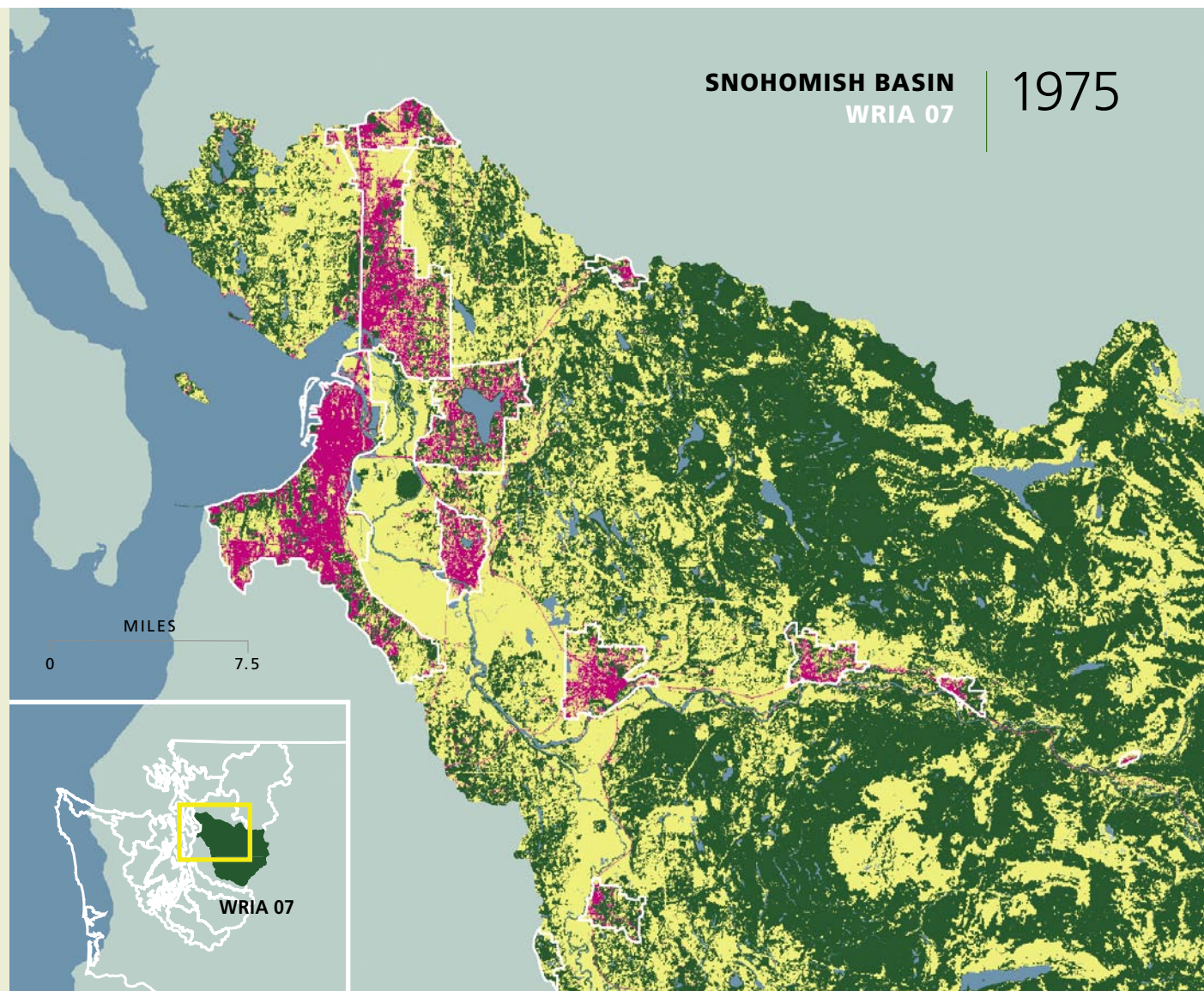
© ROLLIE GEPPERT

- ▶ If we want to keep the effects of water use in 2020 consistent with today's environment, our per capita use number will need to decline another 25%.

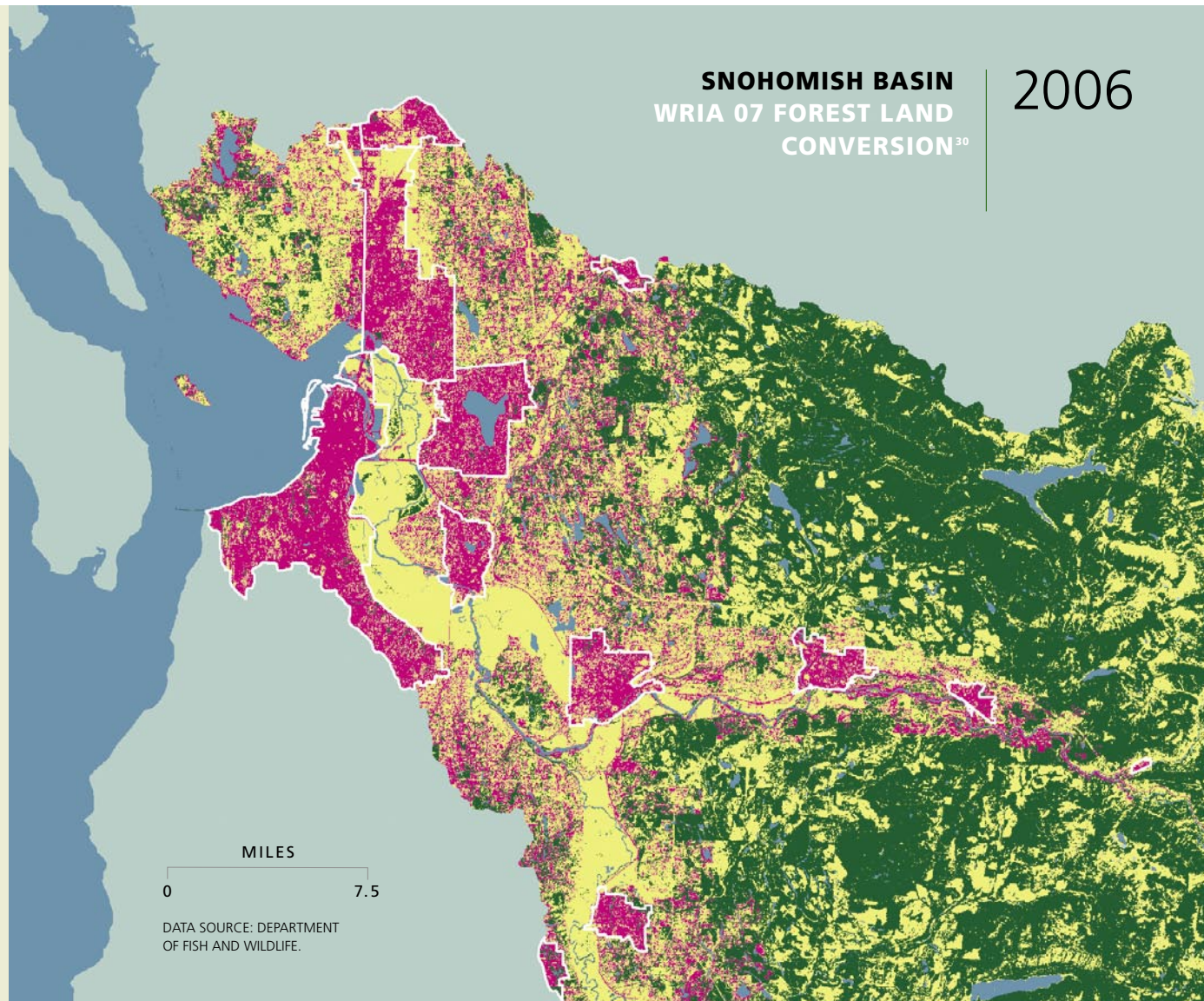
The Impact of Habitat Conversion

As our population grows, we build houses, offices, and other buildings. Habitat fragmentation and loss begin to change ecological communities, some of which are fundamental to the continued existence of salmon:

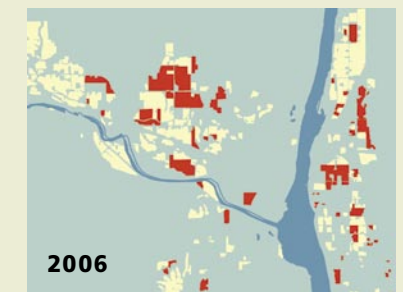
- ▶ Between 45-62% of Washington's estuarine habitats have been lost to diking, channelization, dredging, and/or filling.
- ▶ More than 90% of the wetlands in urban areas have been lost to development.
- ▶ Impervious surface cover increased by more than 7% in an 8 year period in the Puget Sound in the 1990's.
- ▶ In 1970, Washington had 23.1 million acres of forests; in 1992, there were 20.9 million acres. Nearly 10% of our state's forests were converted to other uses over 20 years.
- ▶ By 1979, Washington had lost an estimated 70% of the estuarine wetlands that existed prior to 1800; coastal urban areas have lost 90-98%.



- Conifer Forest
- Developed / Impervious Surface
- Urban Growth Boundary
- Other Land



AGRICULTURAL LAND CONVERSION IN WENATCHEE BASIN WRIA 45



- Agricultural Land
- Agricultural Land Converted to Development

MILES
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The Impact of a Changing Climate³¹

Climate change is projected to affect the Pacific Northwest (PNW) and its salmon in significant ways. Research conducted by the Climate Impacts Group at the University of Washington projects changes in average annual temperature on the order of 2°F by the 2020s and 3°F by the 2040s. Increases in temperature are expected during all seasons with the largest increases occurring during the summer months (June–August). Changes in precipitation are less certain than temperature, but most climate models project modest increases (0–10%) in precipitation with most of the increase coming during the winter (October–March).

Warmer winter temperatures will have a major impact on PNW snowpack and streamflow. Warmer temperatures will cause more winter precipitation to fall as rain rather than snow, particularly in mid-elevation river basins where average winter temperatures are currently near freezing. This shift in temperature and precipitation will contribute to less winter snow accumulation (see next page below), higher winter streamflows, earlier spring snowmelt, earlier peak spring streamflow, and lower summer streamflows. Warmer summer temperatures are also likely to increase summer streamflow temperatures (see next page above).

The projected changes in streamflows and water temperature will have diverse impacts on PNW salmon due to salmon's complex lifecycle, and will compound existing stresses from lost and degraded habitat, harmful hatchery practices, dams, and fishing. While some impacts may be positive—warmer winter temperatures may benefit some salmon populations by increasing their growth rates and/or food availability in some streams—climate change impacts on salmon in freshwater are likely to be overwhelmingly negative for many stocks. For example:

- ▶ Increased winter streamflows and earlier peak streamflows can increase the frequency of redd-scouring and juvenile-flushing flood events;
- ▶ Lower summer streamflows and warmer stream temperatures may reduce the extent and quality of rearing habitat for juveniles, and may increase the potential for physical and thermal barriers to upstream adult migration in summer and early fall;
- ▶ Warmer summer streamflow temperatures can increase thermal stress for salmon at all life stages; and
- ▶ Warmer spring and summer water temperatures can lead to changes in freshwater food web dynamics that negatively affect salmon.

Climate change impacts on the marine environment are also important but are currently not well understood. Research on past variability tells us, however, that warmer ocean temperatures lead to changes in the marine food web that are generally unfavorable to PNW salmon. These changes are due in part to increased coastal ocean stratification, which reduces food-web productivity by inhibiting upwelling of nutrients from deeper, colder ocean depths. Warm ocean temperatures also allow warm-water predators such as Pacific hake and mackerel to expand their range into the coastal waters of the PNW. The combination of reduced food-web productivity, increased predation, and increased competition has historically caused severely reduced ocean survival rates for many PNW salmon stocks (especially coho and Chinook). Increased ocean acidification due to rising concentrations of atmospheric carbon dioxide may also negatively affect the upper ocean food webs on which salmon depend, but at this time the food web consequences are largely unknown.

► While some impacts may be positive—warmer winter temperatures may benefit some salmon populations by increasing their growth rates and/or food availability in some streams—climate change impacts on salmon in freshwater are likely to be overwhelmingly negative for many stocks.

